UNMANNED WATERCRAFT RETRIEVAL SYSTEM

[0001] The present invention relates generally to the retrieval of watercraft.

STATEMENT OF GOVERNMENT INTEREST

[0002] The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefore.

BACKGROUND OF THE INVENTION

[0003] Current methods for retrieving unmanned waterborne vehicles such as small boats onto a retrieval ship often involve use of cranes or davits to lower some attachment device such as a hook from the retrieval ship onto the small boat to be retrieved. Under high sea state conditions, such retrieval methods become operationally difficult and inadequate because of the high winds and sea waves. In view of such retrieval difficulties, current practice often involves use of personnel to control maneuvering of the small boat to be retrieved, and manipulation of the crane suspended hook for attachment purposes. Such retrieval methods have therefore been become extremely difficult to perform and time consuming. It is therefore an important object of the present invention to provide a mostly underwater retrieval system which avoids use of the attachment lowering crane or davit and is fully automated to perform retrieval of a small boat under low to high sea state conditions.

SUMMARY OF THE INVENTION

[0004] Pursuant to the present invention, an underwater towed body connected by a towing line to a retrieval ship, is automatically maneuvered by adjustable steering rudder fins thereon under control of tracking signals emitted by a beacon from an unmanned vehicle such as a floating watercraft or submarine to be retrieved by docking thereof onto the retrieval ship. The towed body is thereby maneuvered into an aligned position relative to the unmanned vehicle for attachment thereto in order to induce its movement toward the retrieval ship for docketing thereof on the retrieval ship.

DESCRIPTION OF THE DRAWINGS

[0005] A more complete appreciation of the invention and many of its attendant advantages will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing wherein:

[0006] FIG. 1 is a side elevation view of an underwater retrieval body positioned between a retrieval ship and an unmanned watercraft to be retrieved;

[0007] FIG. 2 is a top plan view of the underwater retrieval body shown in FIG. 1;

[0008] FIG. 3 is an end view of the underwater retrieval body as viewed from section line 3-3 in FIG. 1;

[0009] FIG. 4 is a partial side elevation view showing the unmanned watercraft hooked to the underwater retrieval body during a retrieval process;

[0010] FIG. 5 is a partial side elevation view showing docking of the unmanned watercraft onto the retrieval ship;

[0011] FIG. 6 is a diagram of automated maneuvering controls associated with the underwater retrieval body;

[0012] FIG. 7 is a partial section view taken substantially through a plan indicated by section line 7-7 in FIG. 3;

[0013] FIG. 8 is a side elevation view of an underwater retrieval body in accordance with another embodiment;

[0014] FIG. 9 is a top plan view of the underwater retrieval body shown in FIG. 8;

[0015] FIG. 10 is an end view of the underwater retrieval body shown in FIGS. 8 and 9;

[0016] FIG. 11 is a partial section view taken substantially through a plane indicated by section line 11-11 in FIG. 10;

[0017] FIG. 12 is a partial side elevation view of the underwater retrieval body illustrated in FIGS. 8-11, positioned adjacent to an unmanned watercraft to be retrieved; and

[0018] FIG. 13 is a partial side elevation view of attachment of the watercraft shown in FIG. 12 attached to the underwater retrieval body shown in FIG. 8 during retrieval movement toward a retrieval ship.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0019] Referring now to the drawing in detail, FIGS. 1-5 illustrate a relatively small unmanned vehicle 10 such as a watercraft floating in seawater 12 at some location from which it is to be retrieved by docking on board a seawater retrieval ship 14. Retrieval of the unmanned watercraft 10 as hereinafter explained involves use of a small size towed retrieval body 16 connected by a towing line 18 to the retrieval ship 14. The unmanned watercraft 10 may be powered and refueled from some external source as generally known in the art before being engaged by the towed body 16 for retrieval by docketing onto the ship 14.

[0020] In FIG. 1, the unmanned watercraft 10 is shown located adjacent to but disengaged from the retrieval body 16 at the beginning of a retrieval process. In FIG. 4, the unmanned watercraft 10 is shown engaged by the retrieval body 16 so as to be towed thereby through the towing line 18 toward the retrieval ship 14 shown in FIGS. 1 and 5 with a docking platform 20 pivotally mounted thereon, from which the towing line 18 is extended and through which it is reeled into a cable storage roll 22. When the unmanned watercraft 10 is attached to the retrieval body 16 as shown in FIG. 4, it may be towed therewith toward the retrieval ship 14 during reel in of the towing line 18 in order to accommodate reception thereof onto the pivotally inclined docking platform 20 as shown in FIG. 5. The docking platform 20 may then be pivotally displaced to its retracted horizontal position with the towing line storage roll 22 received in a receptacle 24 for docking retention of the watercraft 10 onboard the retrieval ship 14.

[0021] Referring now to FIGS. 1, 2, 3 and 4, the retrieval body 16 according to one embodiment has a forward convergent bow end 26 to which the towing line 18 is connected. A pair of angularly adjustable control surface rudder fins 28 extend vertically upward from the top of the body 16, while a rudder fin 30 is fixed to the bottom of the body 16 between elongated legs

32 also fixed thereto. Angularly adjustable side fins 34 extend laterally from the sides of the towed body 16. The rudder fins 28 and 34 are angularly adjusted under automated control so as to maneuver the body 16 while attached to the towing line 18 relative to the unmanned watercraft 10 as shown in FIG. 1, for attachment thereto by hooked engagement therewith as shown in FIG. 4.

[0022] Aft end portions 36 on the retrieval body 16 are downwardly inclined as shown in FIGS. 1-3 for support of a pair of poles 38 in lowered positions, pivotally connected at their upper ends to the body 16 by pivot anchors 40. The lower ends of the poles 38 suspend therefrom a wire loop 42 so as to be positioned in underlying relation to a hook 44 projecting from the unmanned watercraft 10 in its aligned position adjacent to the body 16 as shown in FIGS. 1 and 3. Thus, the poles 38 when raised from their lowered position as shown in FIG. 4 engage the wire loop 42 with the hook 44 so as to attach the watercraft 10 to the body 16 for towing to and retrieval docking on the ship 14.

[0023] Also positioned on top of the retrieval body 16 at its aft end between the pole pivot anchors 40 is a guidance lens scanner 46 connected to a photocell maneuvering array 48, also positioned on the towed body 16 as shown in FIG. 2 and diagrammed in FIG. 6, for maneuvering the body 16 (by the adjustable rudder fins 28 and 34 as aforementioned) under automatic control of an optical homing control system 50. Inputs to the homing control system 50 are received from the photocell array 48 in response to tracking light signals from the guidance lens scanner 46. Such light signals are generated by an optical beacon 52 on the unmanned watercraft 10. Steering command outputs of the maneuvering control system 50 in response to the tracking light signals are accordingly applied through steering actuators associated with the rudder fins 28 and 34. Each of the steering actuators as diagrammed in FIG. 6 may embody an electrically

controlled actuator device 54 for angular steering adjustment of the rudder fin 28 for example as shown in FIG. 7. The steering adjustment actuator device 54 connected to the homing control system 50 has an adjustment rod 56 extending therefrom for pivotal connection through a bell crank 58 to a pivot bearing hinge 60 on the rudder fin 28.

[0024] FIGS. 8-13 illustrate retrieval of the unmanned watercraft 10 by use of a modified form of retrieval body 16' in accordance with another embodiment of the present invention, generally similar to that previously described body 16 except for the manner in which the watercraft 10 is engaged therewith at its rear aft end. Instead of the attachment hook 44 as hereinbefore described, a conical docking probe 62 extends forwardly from the helm of the watercraft 10 as shown in FIG. 12, adapted to be received within the aft end of the body 16' as shown in FIG. 13. The aft end portion of the body 16' is therefore internally provided with a conical guide funnel 64 terminated by a mating socket 66 within which the end portion of the probe 62 is received to establish attachment as well as to provide fueling and electrical connections between the watercraft 10 and the body 16'. A wire netting cage 68 is also anchored to the aft end of the body 16', extending from the funnel 64 for guided reception of the probe 62. Thus modification associated with the body 16' resides in the provision of the guide funnel 64 and the probe socket 66 therein, together with the wire cage 68 for attachment purposes and for fuel and electrical power transmission to the unmanned watercraft 10.

[0025] The foregoing watercraft retrieval process involving use of the retrieval body 16 or 16' may be applied to a submarine type watercraft as in the case of the surface floating watercraft 10 described. Additionally, other modifications and variations of the present invention may be possible in light of the foregoing teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.